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Abstract

ANALYTICAL METHODS IN ENERGY DEPENDENT TRANSPORT THEORY

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The time dependent neutron density in six-dimensional configuration space is of fundamental importance for the computation of the various parameters and functions describing a reactor. It is solution of the Boltzmann equation with special boundary and initial values that are determined by the reactor under consideration. The collision operator on the right side of the equation depends only in the collision and transport properties of the reactor medium. They also can depend in space and time:

$$\int d\vec{v}' K(\vec{v}' - \vec{v}, \vec{x}, t) = 1^{-1}(\vec{x}, \vec{v}, t)$$

There is a variety of approximation methods. They make possible numerical calculations with more or less accuracy and security. Concerning the existence and structure of the solutions there are only a few papers (1958, G.M. Wing). Using real and complex analysis they give complete and rigorous solutions of the energy in dependent Boltzmann equation and demonstrate that some folklore common to textbooks in reactor theory turns to be false. The operators appearing in the energy dependent Boltzmann equation or in derived equations are not selfadjoint. These operators are more general than the observables usually used in quantum-mechanics. This fact complicates the solution of the problem. Using the theory of linear operators in Hilbert space two major examples are considered in detail:

- (1) The stationary neutron spectrum in an unbounded reactor and
- (2) The time dependence of the neutron density in a slab reactor.

The basis models of the computation are very realistic. No mathematical approximations are made. So one can expect that good approximation methods can be derived with an arbitrarily given degree in accuracy in contrast to all other methods.